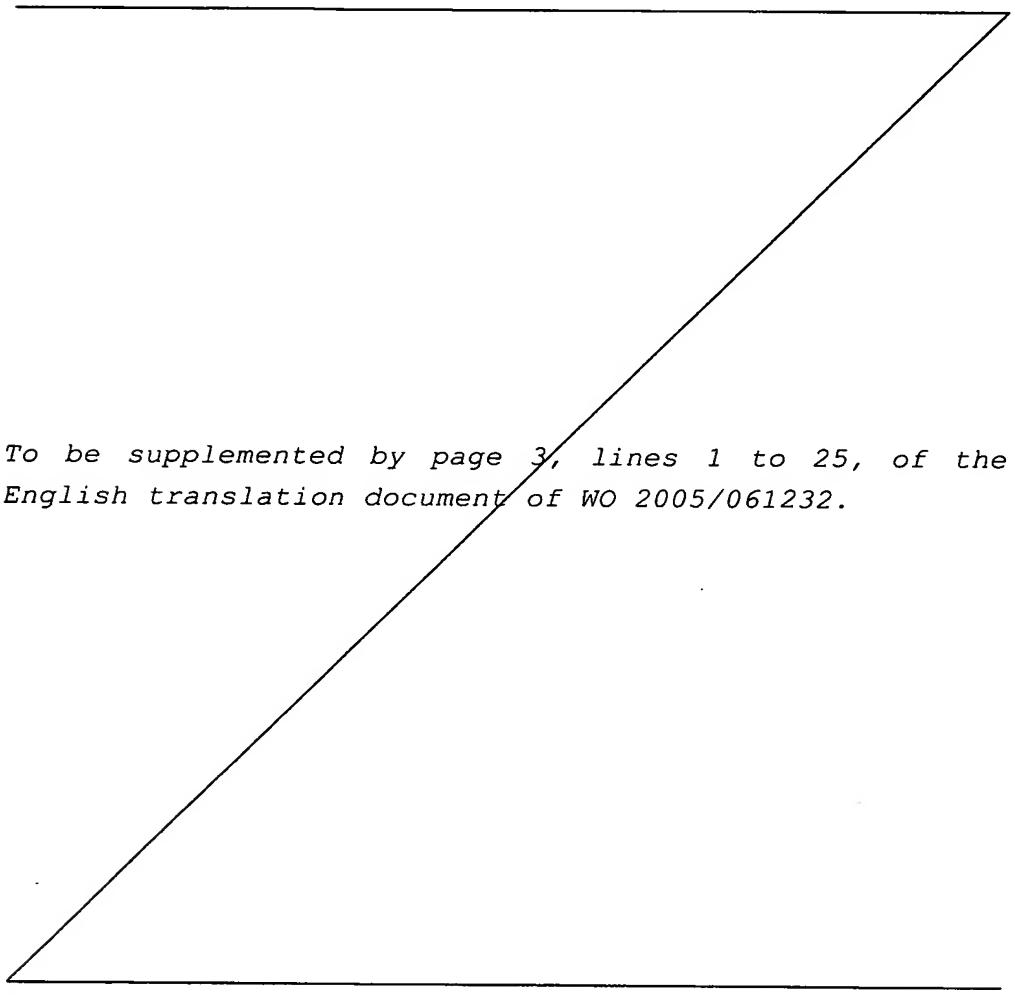

To be supplemented by page 3, lines 1 to 25, of the English translation document of WO 2005/061232.

EP 0 562 149 A1 further discloses a device for processing thin-walled hollow cylinders by means of a laser beam, in which a laser processing head is arranged alongside a hollow cylinder that is rotatably mounted about its longitudinal axis, such as for example a blank for a screen stencil or the like, on a carriage which is displaceable parallel to the longitudinal axis of the hollow cylinder to be processed. Along with the laser processing head, a supporting bearing for the hollow cylinder is fixedly mounted on the carriage, so that it can be moved

together with the carriage in the axial direction of the hollow cylinder.

The supporting device comprises a lower bearing bracket substantially in the form of a half-circle and an upper bearing bracket in the form of a quarter-circle, which is pivotably mounted to permit the automatic loading of a hollow cylinder.

The lower bearing bracket, which may be equipped with a multiplicity of bearing rollers, has a substantially U-shaped profile, which is closed at the extreme ends so as to form a suction channel, which can be connected by means of a corresponding vacuum extraction connecting piece to a suitable vacuum extraction unit in order to produce a slight negative pressure in the suction channel, which ensures that the hollow cylinder is kept in reliable contact with the lower bearing bracket of the supporting device, in order to ensure reliable, vibration-free guidance of the hollow cylinder in its respective processing region, so that precise laser processing is possible.

Furthermore, in particular when processing organic materials, the material often continues to glow, which can be observed over a quarter or half revolution or more, and which consequently leads to fumes and/or vapor developing outside the extraction region. Even in the case of nonorganic materials, such as zinc for example, continued glowing may occur, leading to decomposition products occurring not only close to the region of interaction of the radiation and the workpiece.

Although such fumes or vapor can be prevented from escaping into the environment by complete encapsulation

of the processing machine, they then lead to the machine itself becoming soiled.

DE 103 05 258 describes a device for the protection of optical elements for laser imaging, in which a food source and a vacuum sink are used to form a transverse flow in front of the optical element to be protected, in order to protect it from deposits of abrasion and/or decomposition products from the region of interaction between the laser and the material surface. With this device, the part of the abrasion and/or decomposition products detached from a surface by the laser radiation that is taken up by the transverse flow is also extracted.

EP 1 090 709 describes a laser engraving head in which a chamber is arranged in front of a focusing lens and is fed compressed air that leaves together with the focused laser beam through an opening. Part of the compressed air is extracted in front of the opening through gaps via vacuum extraction connections to a vacuum extraction line. Part of the compressed air from the chamber leaves through the opening as a rotationally symmetrical air stream, which prevents abrasion and/or decomposition products from the region of the zone of interaction between the laser beam and the workpiece from penetrating into the chamber and takes them with it into the surroundings.

The invention is based on the object of providing a further vacuum extraction unit of the type mentioned at the beginning with which abrasion and decomposition products created during the processing of cylindrical workpieces, such as for example aerosols, vapors, fumes, gases and the like, are prevented from escaping into the environment.

This object is achieved by the vacuum extraction unit as claimed in claim 1. Advantageous refinements and developments are described in the subclaims.

Therefore, according to the invention, a vacuum extraction unit has a hood for covering a region of interaction between the radiation and the workpiece surface and a C-shaped cover ring. The hood thereby comprises a vacuum extraction channel, the inlet opening of which lies opposite the workpiece surface in the operating position of the hood and can be connected to a vacuum extraction line. The C-shaped cover ring comprises two ends that follow the circumference of the workpiece and are located at a distance from each other, and has a substantially U-shaped cross section, the hood being arranged adjacent one of the two circumferential ends of the cover ring and extraction means being provided at the other circumferential end.

The arrangement according to the invention of a cover ring which extends at least partially around a cylindrical workpiece has the effect of forming an annular channel between the cover ring and the cylindrical workpiece, in which channel a circumferential air flow forms on account of the rotation of the workpiece during processing and is extracted by means of the hood arranged adjacent one

end of the cover ring. In principle, it is also conceivable to provide the cover ring with an extraction means of its own, for example in its outer circumferential region.

The C-shaped cover ring may in this case extend partially or virtually completely around a cylindrical workpiece. In the latter case, its two circumferential ends lie adjacent the hood. In the former case, it may extend over 90°, 120°, 180° or any other angular range which is adequate to allow fumes, vapors, small particles or the like to be captured and extracted.

It is preferred, however, that the cover ring extends so far around the workpiece that the hood then lies between its circumferential ends and extracts the flow there, so that a certain negative pressure is created in the annular channel, on account of which its air is sucked in through the intermediate space between the side walls of the cover ring and the workpiece, so that fumes, vapors or gases which are given off from the workpiece underneath the cover ring on account of the processing of the material can be reliably prevented from penetrating to the outside. Rather, the fumes, vapors or other gases are taken up by a circumferential flow on account of the rotation of the workpiece and carried to the hood of the vacuum extraction unit, where they are transported away together with other abrasion and decomposition products from an engraving zone, that is from a region of interaction between the radiation and the workpiece surface.

In the case of an advantageous development of the invention, it is provided that the C-shaped cover ring is exchangeable, in order that when processing cylindrical workpieces with different diameters a cover

ring from a number of cover rings can be respectively chosen and used, the inside diameter of which ring is adapted as well as possible to the diameter of the cylindrical workpiece respectively to be processed. In this way, optimum sealing can be achieved for fumes, vapors or the like.

According to another refinement of the invention, it is also possible that the side walls of the C-shaped cover ring are provided with means for reducing its free inside diameter, so that said ring can be set to correspond to the diameter of the cylindrical workpiece respectively to be processed, the means for reducing the free inside diameter of the C-shaped cover ring preferably comprising a lamellar seal, the individual lamellae of which are pivotably fastened to the side walls of the cover ring. This arrangement permits very flexible adaptation of the cover ring to different workpiece diameters.

The means for reducing the free inside diameter of the C-shaped cover ring may, however, also be formed by exchangeable side parts, in particular side plates.

A particularly advantageous development of the invention is distinguished by the fact that the C-shaped cover ring is circumferentially subdivided into at least two ring segments, which are pivotably held against each other.

In this case it is particularly expedient if the C-shaped cover ring is circumferentially subdivided into three ring segments of different circumferential lengths, the circumferential length of an upper ring segment corresponding approximately to half the

circumferential length of the cover ring, while the lower ring portion has two shorter ring segments.

To improve the extraction of the air from the annular channel formed by the cover ring, it is advantageous if a vacuum extraction nozzle is arranged as extraction means in an intermediate space between the hood and the other circumferential end of the C-shaped cover ring that is located upstream of the hood.

According to another development of the invention, it is provided that the hood has a rear side to which a vacuum extraction line can be connected, two side walls, which have end edges which lie opposite the workpiece in the operating position of the hood, and two directing walls, which are located between the side walls, extend transversely in relation to the latter and which together with the two side walls delimit the vacuum extraction channel in the hood, an edge of one of the two directing walls lying opposite the workpiece in the operating position of the hood, while the other directing wall has a convex, cylindrical curvature lying opposite the workpiece surface in the operating position of the hood and, in the region of this curvature, at least one opening, through which the radiation for processing the workpiece surface is guided. As a result, a high extraction rate is ensured in the region of interaction between the radiation and the workpiece.

A further refinement of the invention is distinguished by the fact that the hood has a rear side, to which a vacuum extraction line can be connected, two side walls, which have end edges with a contour which is adapted to the contour of the surface of a workpiece to be processed, so that corresponding gap seals are

formed when the end edges lie opposite the workpiece in the operating position of the hood, and two directing walls, which are located between the side walls, extend transversely in relation to the latter and which together with the two side walls delimit the vacuum extraction channel in the hood,

To be continued by page 9, lines 2 to 37 of the English translation of WO 2005/061232